that between two charged wires as his starting point, he builds up by simple processes the most important practical cases. His paper concludes with a warning against the frequent use of the idea of potential in cases in which the simpler one of the electric field will give all the required information.

OUR ASTRONOMICAL COLUMN.

THE ORIGIN OF SOLAR ELECTRICITY.—Among the many interesting papers concerning astrophysical matters which appear in No. 8 of the *Monthly Notices* of the Royal Astronomical Society, attention may be directed to a convincing contribution to our knowledge of the agencies originating the vast solar electrical phenomena demonstrated by the brilliant researches effected at Mount Wilson. In a paper under the above title Dr. J. A. Harker applies the results of laboratory work conducted in collaboration with Dr. G. W. C. Kaye at the National Physical Laboratory to the explanation of cosmical phenomena. This experimental work has shown that at very high temperatures the vapours in the tube resistance furnace become highly conducting, and that under the same condition most refractory substances emit electricity carried by particles many times the mass of an atom of the substance. Calculations show that the measured emissivity of carbon at about 3000° C. would be ample to account for solar currents of magnitude sufficient to give rise to the intense magnetic fields Professor Hale has shown to be probably found in sun-spots.

THE TRUE FORM OF THE EARTH AND ITS INTERNAL CONSTITUTION.—Dr. A. Veronnet contributes a discussion of these subjects to No. 13 of the *Revue Générale des Sciences*. It is now known that this "somewhat irregular round body" on which we live has a rough sort of tetrahedral shape, but mathematicians must have a more generalised form, and thus for them the geoid is an ellipsoid of rotation of which the inverse of the eccentricity is about 297. Dr. Veronnet criticises the various formulæ which have been suggested to represent the hypothetical generating curve, and has himself proposed a new one. By considering the effect of variations of density and velocity of rotation limits are determined for the above-mentioned ratio, and it is shown that if the above value, found by Helmert, is supported, then the earth rotates as one piece. The author is also led to make some interesting conclusions regarding the effect of tides and causes of earthquakes.

COSMOLOGICAL HYPOTHESES.—At the Science Congress held at Lourenço Marques, Mr. R. T. A. Innes, of the Transvaal Observatory, dealt with this subject, and added one hypothesis more which he referred to as "the explosion hypothesis." He assumes that matter will not indefinitely submit to continued reduction of volume under indefinitely increasing gravitational pressure, but that a time will come when this pressure will "break into the atomic structure of its matter and cause explosions." By such explosions the sun threw off the planets and the latter their satellites; in other stars they caused the formation of multiple systems; new stars are due to the eruptive outbursts accompanying the explosions, and when on a smaller scale and rhythmical they are responsible for the phenomena of variable stars. Mr. Innes, we may remark, has shown an inexplicable eclecticism in choosing his foundation facts; for example, he has ignored the harmonious results obtained by modern workers on the temperatures of the individual stars, but has selected a contrary opinion to the effect that solar type stars are hotter than the white stars.

MAGNETIC SURVEYS.[1]

THE introduction tells us that this is the first of a series of volumes to be published dealing with the researches of the department of terrestrial magnetism of the Carnegie Institution of Washington, founded in April, 1904. These volumes, while principally on terrestrial magnetism, will contain memoirs on allied subjects, such as atmospheric electricity. The present volume treats of all the magnetic observations made *on land* by the department from the beginning of its observational work in 1905 up to the end of 1910. These observations are directed towards the accomplishment of one of the principal objects which the department has in view, viz. the acquisition of the data necessary for a general magnetic survey of the earth.

The first fifty pages deal with the general methods of work, the selection and description of stations, and especially with the field instruments and the taking and reducing of observations. The observational instruments—magnetometers, dip circles, and dip inductors—and auxiliary apparatus are handsomely illustrated in plates 2 to 6. Much experience of field-work has accumulated of late years at Washington, and the instructions to observers merit the careful attention of all interested in survey work. Pp. 51–6 introduce us to the results of the observations, which are chronicled in the later part of the volume. On p. 53 is a list of thirty-five observers whose work is included. Amongst them are several eminent foreigners, including Prof. Palazzo, of Rome, and Profs. Beattie and Morrison, of South Africa, who have observed for a time under the auspices of the Carnegie Institution. The stations observed at number almost 1300, of which more than 1200 are outside the bounds of the United States.

Of the continents, Africa shows the largest number of stations, 386, the great majority of which were occupied in 1907 and 1908 by Profs. Beattie and Morrison. Of the 328 stations in North America, 189 were in Canada or Newfoundland, fifty-nine in Central America, and nine in Greenland. In Asia there were 308 stations. Of these 142 were in China—occupied mainly by Messrs. Edmunds and Sowers—thirty-seven in Persia, thirty-two in Russian and eighty-one in Turkish territory. The observations in Asiatic Turkey were due mainly to Mr. Sligh, but partly to Mr. J. C. Pearson. The latter gentleman seems to have taken all the observations in Persia and in Asiatic and European Russia, and most of those in Egypt. He also observed in Canada, in European Turkey, at Pola, Potsdam, and Kew Observatories, and was amongst the crew of the surveying ship *Galilee*, who observed in Japan, Australia, and New Zealand. His experiences as a traveller should be of interest. Of the remaining stations, 111 were in South America, and 119 in numerous islands in the Pacific and Atlantic Oceans.

The tables of results, pp. 58–100, give for each station the geographical coordinates, the date and hours of observation, the observed values of magnetic declination, inclination, and horizontal force, the instruments used, and the observer's initials. Pp. 101–120 contain interesting extracts from the reports made by the several observers. The rest of the volume is occupied by minute descriptions of the stations, to facilitate their identification. An artistically attractive feature is the reproduction in plates 1 and 7–10 of a number of fine photographs, showing a selection of the stations occupied or scenes in their neighbourhood.

[1] "Researches of the Department of Terrestrial Magnetism. Land Magnetic Observations 1905–10." By L. A. Bauer, Director of the Department. Pp. 185+10 plates. (Washington, D.C.: Published by the Carnegie Institution of Washington, 1912.)

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The work is a striking example of what can be done when scientific zeal and business capacity have behind them resources such as those of the Carnegie Institution. Dr. Bauer and the staff of the department of terrestrial magnetism—both those who took the observations and those who did the necessary office work—are to be congratulated on the progress made towards the achievement of one of their principal objects of ambition, a general magnetic survey of the globe. C. CHREE.

ADVANCE IN ECONOMIC ENTOMOLOGY.

A NOTABLE feature of recent biological research is the attention paid by medical experts to the study of insects. Capt. F. W. Cragg, of the Indian Service, has lately published two Scientific Memoirs (Nos. 54 and 55) of the Medical and Sanitary Departments of the Government of India, which are of importance to students of the anatomy of Diptera. Both memoirs deal with blood-sucking species, No. 54 with *Philaematomyia insignis*, and No. 55 with *Haematopota pluvialis*. The excessively small number of males of the latter fly is believed by Capt. Cragg, after examination of the genitalia of the female insect, to be explained by heavy mortality as the result of pairing. We notice that the bibliography of this paper contains some remarkable misprints, of which "Verh. yool-bat. Gas. Wein" is worthy of record as a piece of unconscious humour! The last published part of the Bulletin of Entomological Research (vol. iii., part 4, December, 1912) contains valuable systematic papers on blood-sucking Diptera, by Mr. E. E. Austen and Prof. R. Newstead, and some very useful diagnoses of the larval stages of African mosquitoes, by Messrs. F. W. Edwards and A. T. Stanton.

The same number of the bulletin is noteworthy for a suggestive paper by Dr. J. Dewitz on the bearing of physiology on economic entomology. The author points out, for example, the importance of a precise knowledge of the effect of stimuli due to light of varying intensity and wave-length if luminous traps for destructive moths are to be used to the best advantage. Temperature is also found to be a factor in the working of this reaction; "the colder the night the fewer the females (and in particular females with eggs) that are caught by acetylene trap-lamps."

In a lately issued bulletin (Entomology, No. 113) of the U.S. Department of Agriculture, Messrs. W. D. Hunter, F. C. Pratt, and J. D. Mitchell describe the principal cactus insects of the United States. The "prickly pears" (Opuntia) are well known as furnishing food and habitation for the cochineal insect; since the decline of the cochineal industry, however, these plants were regarded rather as noxious weeds until the recent recognition of the fact that they furnish valuable fodder for cattle. Insects which injure them are therefore regarded as economically important, and in this short memoir a number of species of various orders are described and figured.

Some very important observations are contained in a small bulletin (No. 203) issued by the Maine Agricultural Experiment Station in 1912. Miss Edith M. Patch has apparently shown that the aphid causing "leaf-curl" on the elm (*Schizoneura americana*) migrates in spring to the apple and other Rosaceæ, and becomes the parent of the aërial colonies of the notorious woolly aphid, *S. lanigera*. The elm is thus the normal host of the sexual forms in autumn, and the apple is to be regarded as an "intermediate" host. The extreme rarity of sexual forms of *S. lanigera* on apple in these countries may perhaps be explained by a similar unsuspected migration here, though our native elm "leaf-curl" aphid (*Schizoneura ulmi*) is generally regarded as distinct from *S. americana*, and identical with the polyphagous root-feeding form, *S. fodiens*.

The gipsy moth (*Porthetria dispar*) and the brown-tail moth (*Euproctis chryssorhoea*) are well-known examples of European insects which, having been introduced into America, have become there very serious pests. From among the voluminous writings of forest entomologists on these species, one or two recent papers are worthy of especial notice. A. F. Burgess gives an account (U.S. Dept. Agric., Entom. Bull. 119, 1913) of the means by which the gipsy moth extends its range. On account of the excessive weight of the female's body, she is unable to fly, though provided with wings, and the spread of the insect from place to place is carried on mostly during the larval stage. The caterpillars are often artificially though unwittingly transported by farm carts, and it appears that one generally unrecognised evil result of automobile traffic is that these destructive insects are carried far more widely and rapidly than formerly by the passage of motors along main roads which are bordered by infested woods. The young larvæ, however, are provided with a natural means of dispersal in form of long hairs, which enable them to be carried by wind for considerable distances. Some ingenious experiments on this subject have been made by erecting tall platforms provided with traps in which the little caterpillars are caught on their aërial journeys.

As these destructive insects were introduced from Europe, the American entomologists have naturally tried the experiment of importing some of their natural enemies, and an exhaustive report on this subject has been published by Dr. L. O. Howard and W. F. Fiske (U.S. Dept. Agric., Entom. Bull. 91, 1912). To summarise the mass of material in this bulletin is impossible, but the magnitude of the work undertaken may be judged from such a fact as that 11,000 egg-clusters of the brown-tail moth were imported from Europe in the autumn of 1906, and 40,000 specimens of a single species of hymenopterous egg-parasite, *Pteromalus egregius*, reared from these were turned out in New England woodlands during the succeeding spring. Many valuable bionomic details with regard to the parasites are recorded, and reference is made to attempts—successful or otherwise—to introduce predaceous enemies of other harmful insects into countries where the latter have themselves obtained a foothold. A short special paper on a cognate subject is R. S. Woglum's report on a trip to India and the Orient in search of the natural enemies of the Citrus white-fly (*Aleyrodes citri*); this forms Bull. 120 of the Entomological Bureau of the U.S. Dept. Agric.

A much-needed systematic monograph of the "white-flies," or "snowy-flies" (Aleyrodidæ) is commenced by A. L. Quaintance and A. C. Baker in the Technical Series, No. 27, of the same bureau. These insects are allied to the Coccidæ and Aphididæ, but have received far less attention from entomologists than those two families. In the work now begun their structure, classification, and bionomics are dealt with as fully as possible in the present state of knowledge; ultimately the authors think that the family may prove as rich in species as the Coccidæ or Aphids.

Another valuable systematic paper of economic interest is Prof. M. Bezzi's memoir on Indian Trypaneids, or fruit-flies (Memoirs Indian Museum, vol. iii., No. 3, 1913). These are small Diptera included in what used to be known as the "acalypterate" series of the Museidæ. The careful, systematic study of such insects is of importance, and Dr. Annandale, the director of the Indian Museum, is to be con-

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